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Yum et al.

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(54) **LIGHT EMITTING DEVICE AND LIGHTING APPARATUS HAVING SAME**

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H01L 33/00 (2010.01)
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(Continued)

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CPC H01L 33/405; H01L 33/22
See application file for complete search history.

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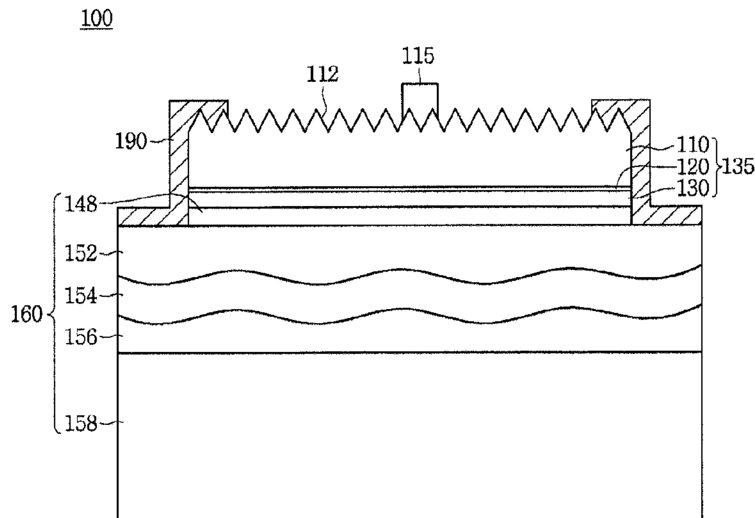
(57) **ABSTRACT**

A light-emitting device discloses a light emitting structure layer including an active layer between first and second conductive semiconductor layers, a first electrode electrically connected to the first conductive semiconductor layer, a contact layer disposed under the second conductive semiconductor layer, a reflective layer disposed under the contact layer, a capping layer disposed under the reflective layer, and a conductive supporting member disposed under the capping layer. The reflective layer comprises a thickness that is greater than the thickness of the second conductive semiconductor layer and 90 or more times greater than the thickness of the contact layer.

20 Claims, 13 Drawing Sheets



(51) **Int. Cl.**

H01L 33/38	(2010.01)
H01L 33/22	(2010.01)
H01L 33/62	(2010.01)
H01L 33/32	(2010.01)

(52) **U.S. Cl.**
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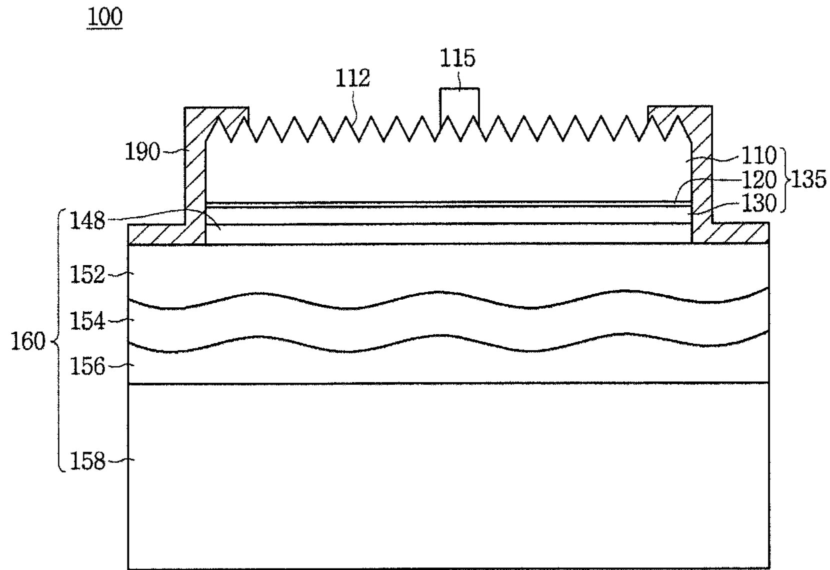
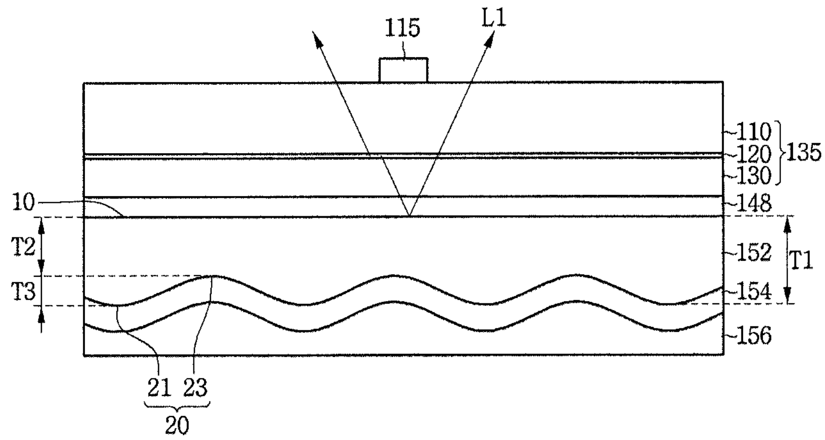
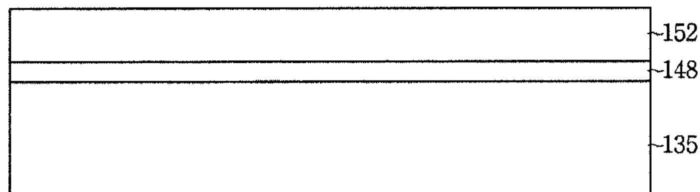
【FIG. 1】



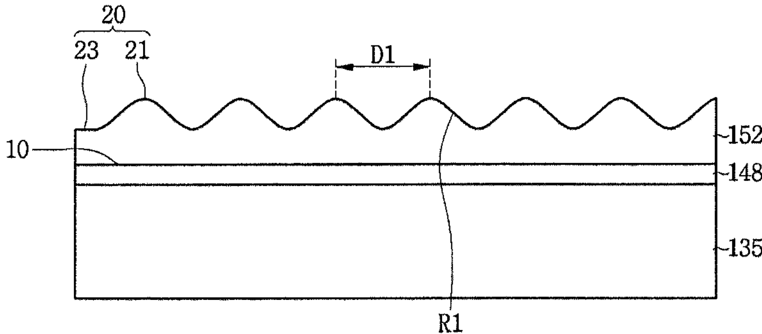
【FIG. 2】



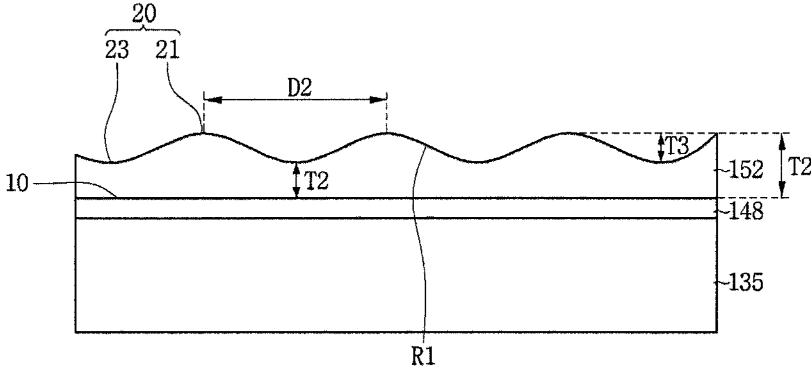
【FIG. 3】



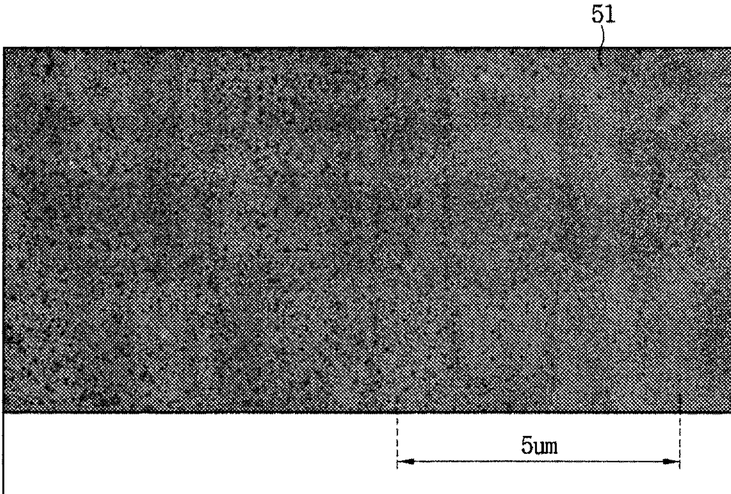
【FIG. 4】



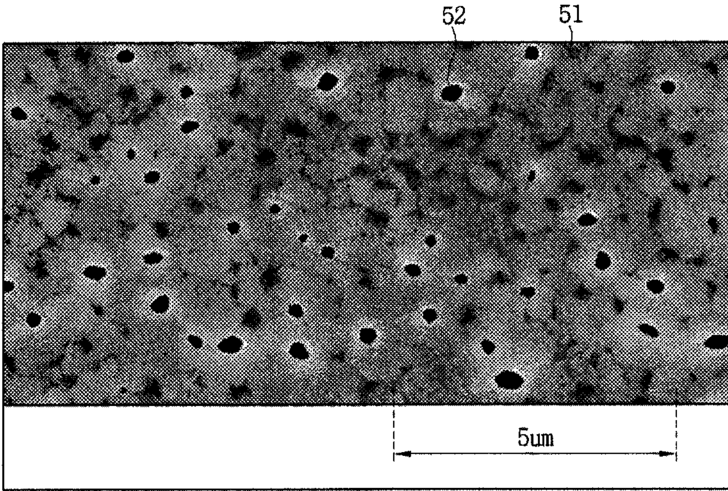
【FIG. 5】



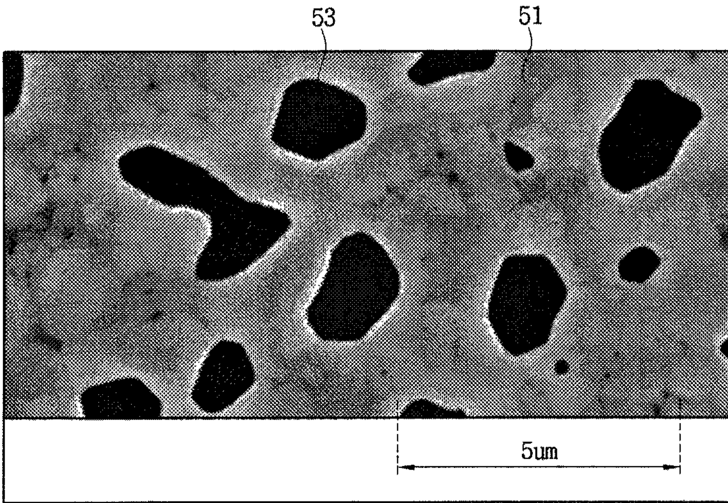
【FIG. 6】



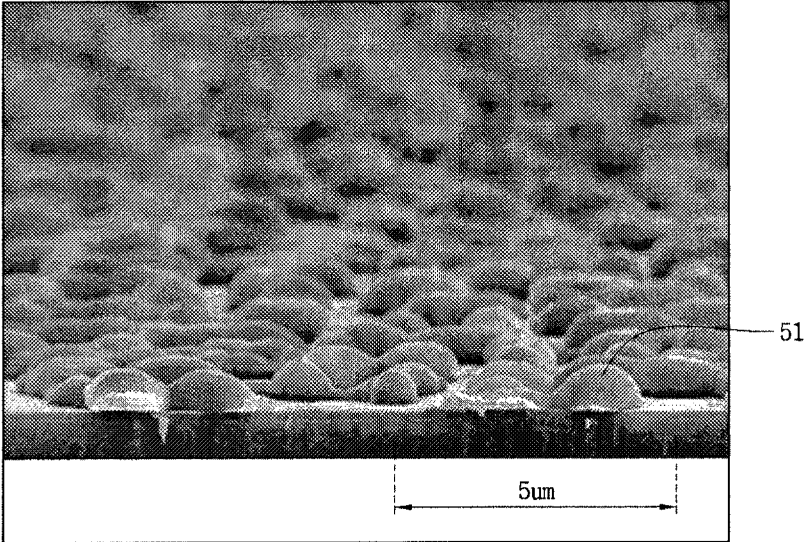
【FIG. 7】



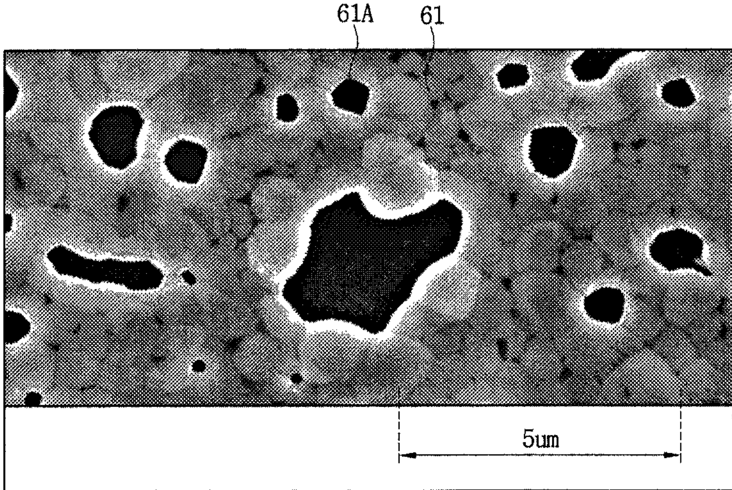
【FIG. 8】



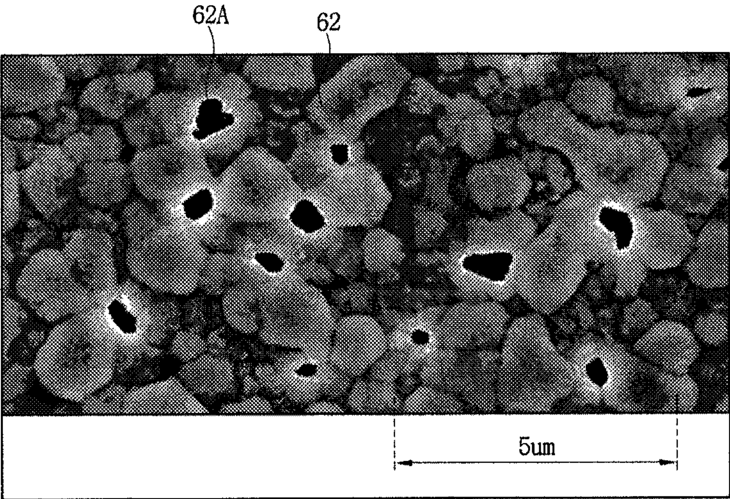
【FIG. 9】



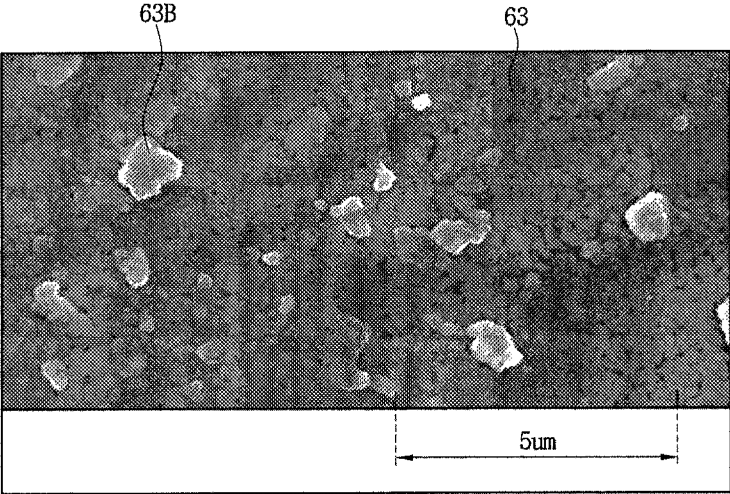
【FIG. 10】



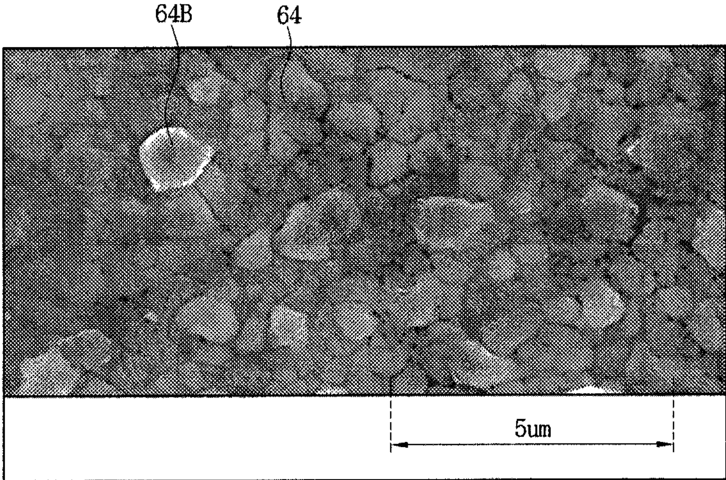
【FIG. 11】



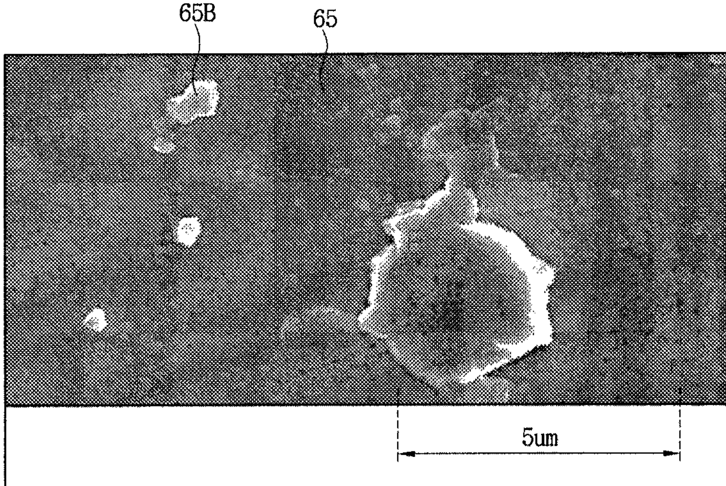
【FIG. 12】



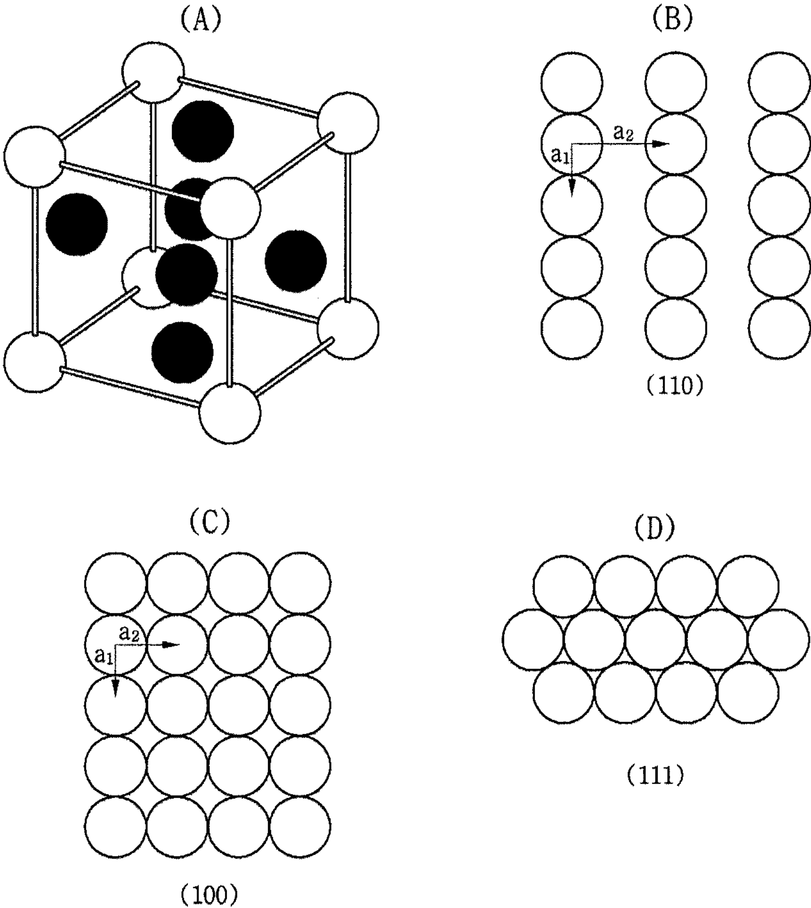
【FIG. 13】



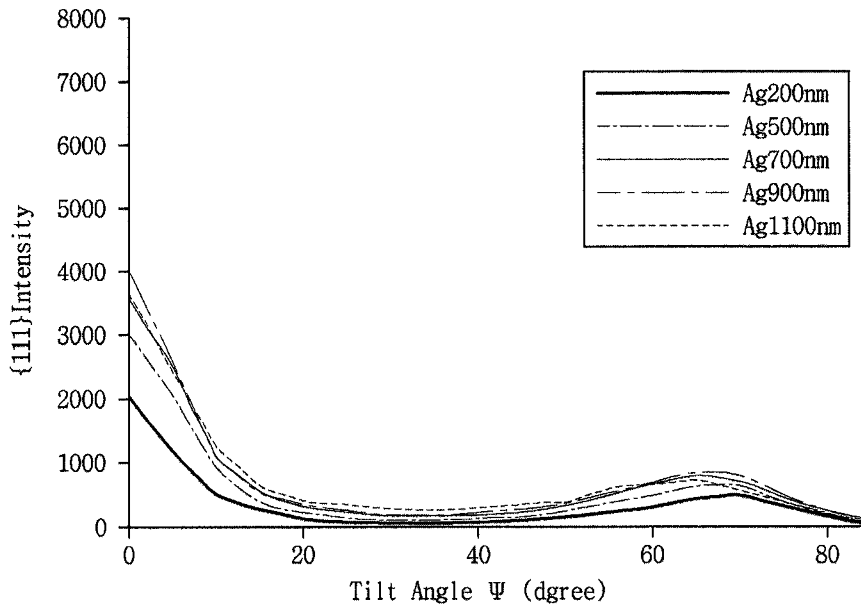
【FIG. 14】



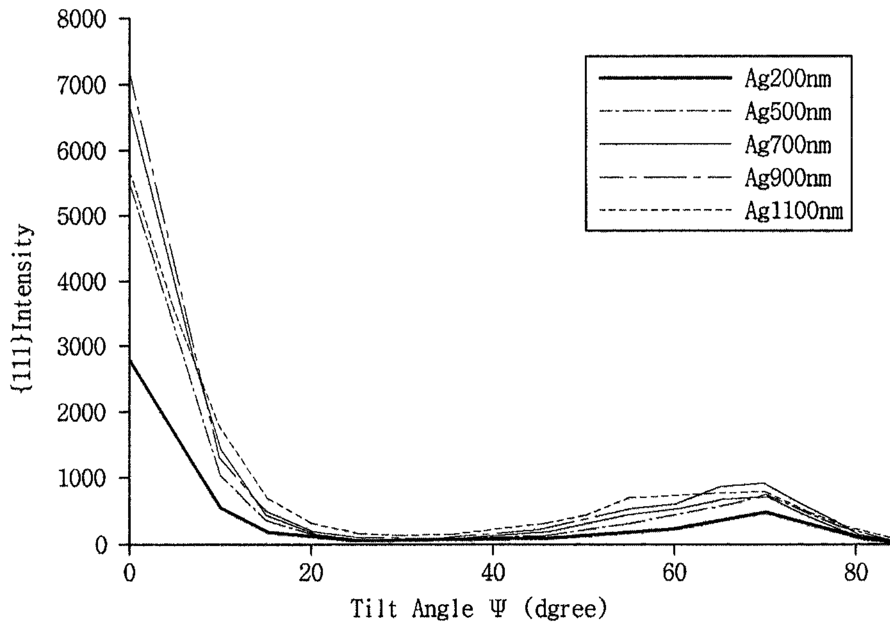
【FIG. 15】



【FIG. 16】



【FIG. 17】



【FIG. 18】

No.	Test	Po [mW]	Po ↑
01	Ref	518.7	
	900nm	531	12.3 (2.37%)

(A)

No.	Test	Po [mW]	Po ↑
02	Ref	527.04	
	900nm	541.98	14.94 (2.83%)

(B)

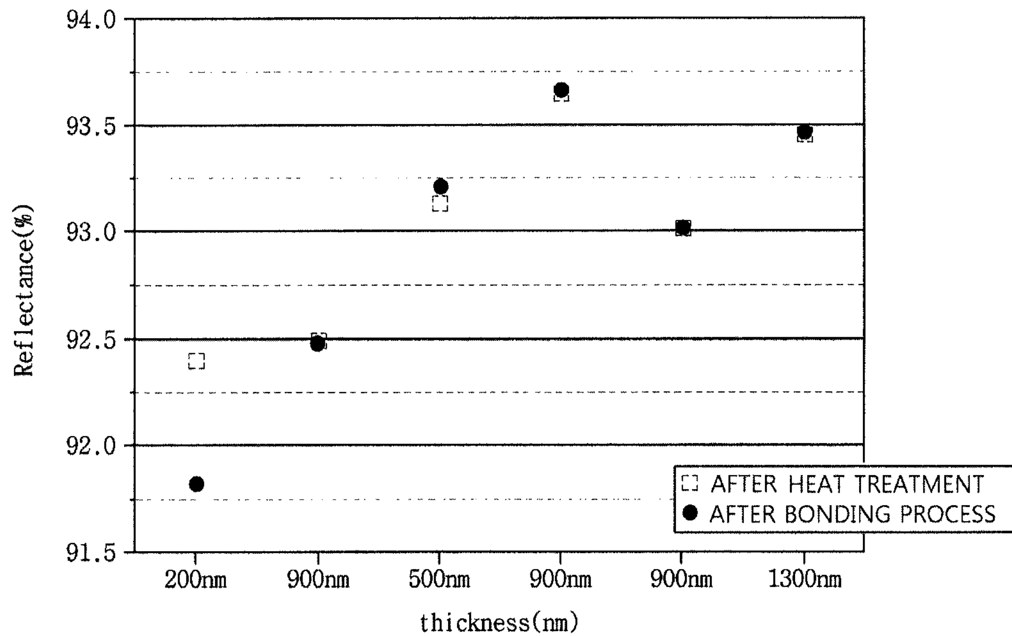
No.	Test	Po [mW]	Po ↑
03	Ref	526.92	
	900nm	541.03	14.11 (2.63%)

(C)

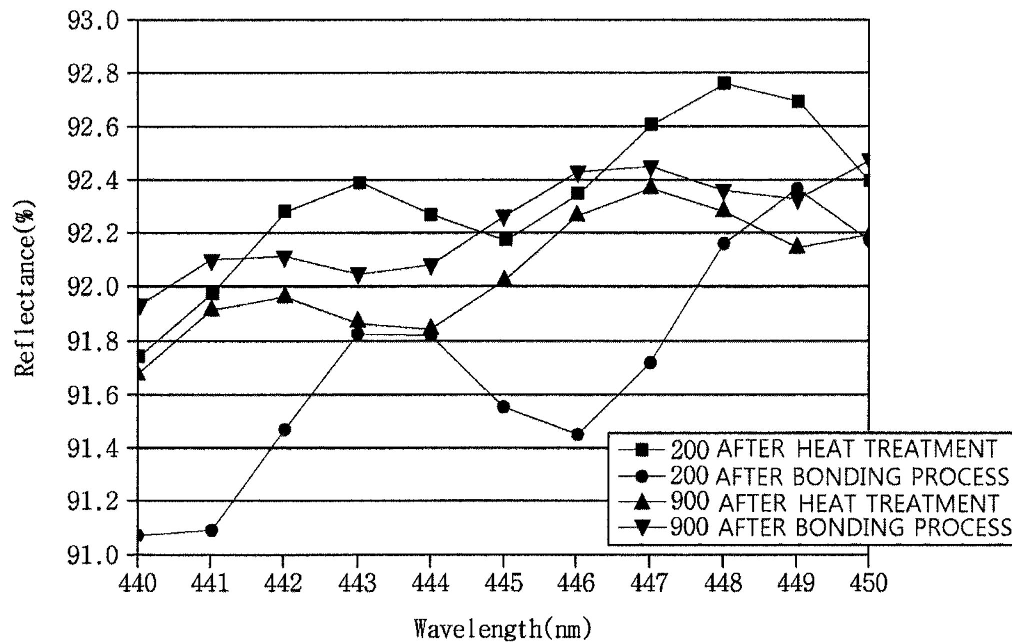
【FIG. 19】

	Wafer 1		Wafer 2		Wafer 3	
	200nm	900nm	500nm	900nm	900nm	1300nm
HEAT TREATMENT AT 400°C	92.4	92.49	93.13	93.65	93.01	93.45
AFTER BONDING PROCESS	91.82	92.48	93.21	93.66	93.01	93.46
Δreflectance flectance	-0.58	-0.01	0.08	0.01	0	0.01

【FIG. 20】



【FIG. 21】



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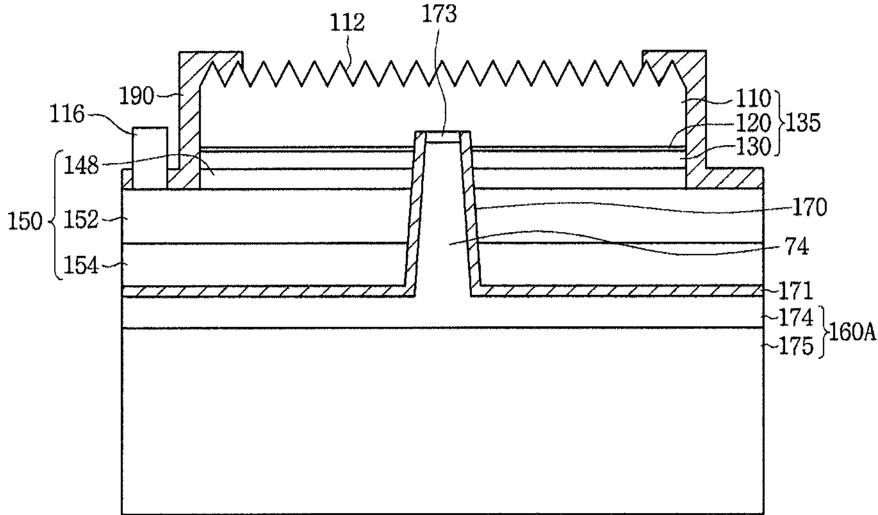

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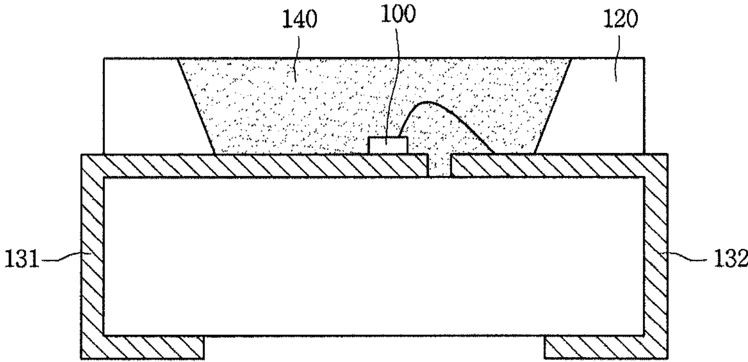
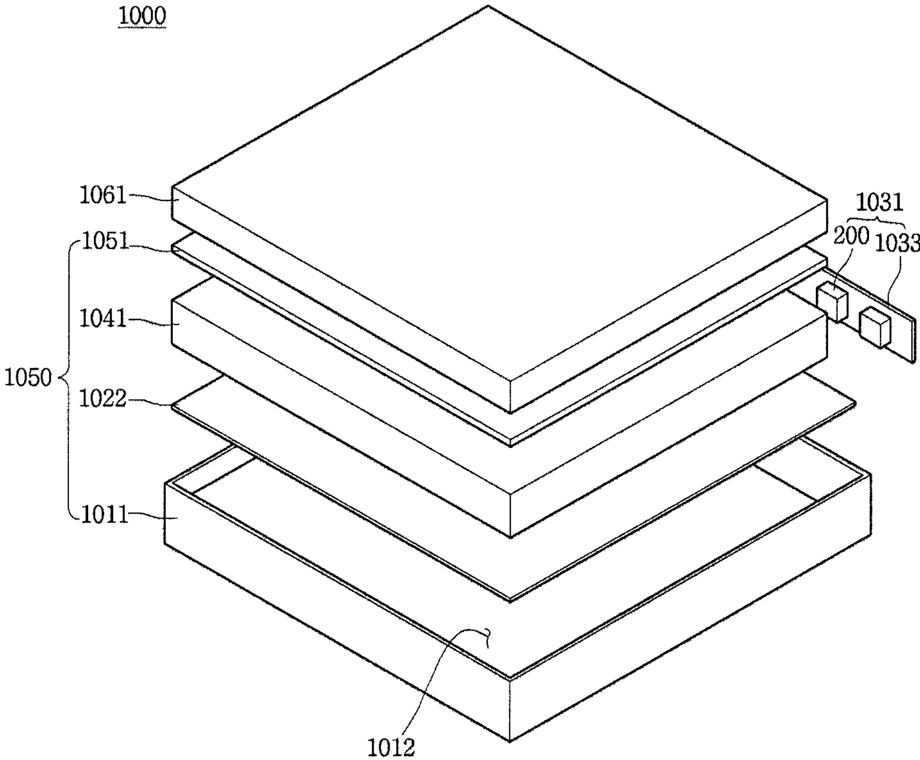
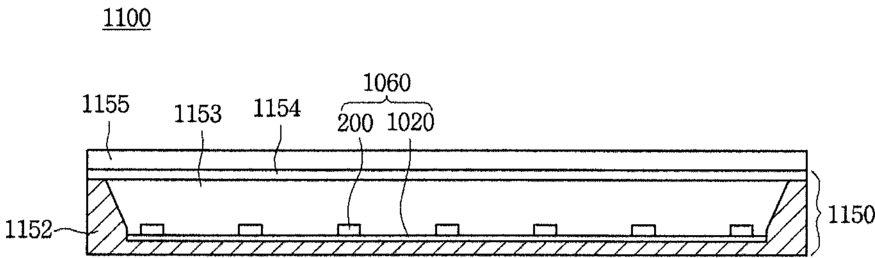


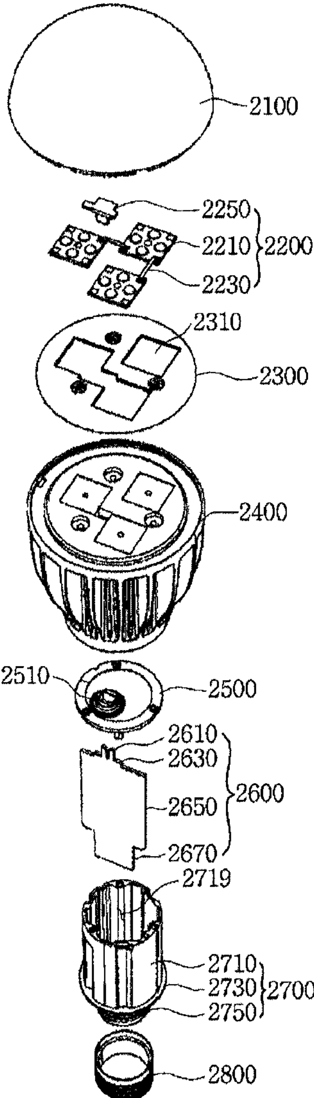
【FIG. 24】



【FIG. 25】



【FIG. 26】



LIGHT EMITTING DEVICE AND LIGHTING APPARATUS HAVING SAME

CROSS REFERENCE TO RELATED APPLICATIONS

This application is the National Phase of PCT/KR2015/003294 filed on Apr. 2, 2015, which claims priority under 35 U.S.C. §119(a) to Korean Patent Application No. 10-2014-0039992 filed on Apr. 3, 2014, all of which are hereby expressly incorporated by reference into the present application.

TECHNICAL FIELD

Embodiments relate to a light emitting device and a lighting apparatus including the same.

BACKGROUND ART

Group III-V nitride semiconductors have been spotlighted as a core material of light emitting devices, such as light emitting diodes (LEDs) or laser diodes (LDs), due to physical and chemical characteristics thereof. A Group III-V nitride semiconductor is generally formed of a semiconductor material having a formula of $I_xAl_yGa_{1-x-y}N$ ($0 \le x \le 1$, $0 \le y \le 1$, $0 \le x+y \le 1$).

A light emitting diode (LED) is a semiconductor device which converts electricity into infrared or visible light using characteristics of compound semiconductors to exchange signals, and is used as a light source.

LEDs or LDs using such a nitride semiconductor material are widely used for light emitting devices for obtaining light and are used as light sources of various types of products such as a keypad light emitting unit of a mobile phone, a display apparatus, an electronic display board and a lighting apparatus.

DISCLOSURE

Technical Problem

Embodiments provide a light emitting device having improved luminosity.

Embodiments provide a light emitting device in which a reflective layer is disposed under a light emitting structure layer and a depth of a recess of the reflective layer is less than a thickness of the reflective layer.

Embodiments provide a light emitting device in which a through-hole is not formed in a reflective layer disposed under a light emitting structure layer.

Technical Solution

A light emitting device according to an embodiment includes a light emitting structure layer including a first conductivity type semiconductor layer, a second conductivity type semiconductor layer disposed under the first conductivity type semiconductor layer and an active layer disposed between the first conductivity type semiconductor layer and the second conductivity type semiconductor layer, a first electrode electrically connected to the first conductivity type semiconductor layer, a contact layer disposed under the second conductivity type semiconductor layer and formed of a conductive material, a reflective layer disposed under the contact layer, a capping layer disposed under the reflective layer, and a conductive support member disposed under the capping layer. A thickness of the reflective layer is greater than that of the second conductivity type semiconductor layer and is 90 or more times that of the contact layer.

Advantageous Effects

Embodiments can improve light output of a light emitting device.

Embodiments provide a light emitting device capable of improving reflectance of a reflective layer disposed under a light emitting structure layer.

Embodiments can improve optical property deterioration of a light emitting device.

Embodiments can improve reliability of a light emitting device and a light emitting device package, lighting apparatus and display apparatus including the same.

DESCRIPTION OF DRAWINGS

FIG. **1** is a side cross-sectional view showing a light emitting device according to a first embodiment.

FIG. **2** is a partial enlarged view showing a reflective layer of the light emitting device of FIG. **1**.

FIGS. **3** to **5** are views showing change of the reflective layer according to heat treatment in the light emitting device of FIG. **2**.

FIGS. **6** to **9** are views showing surfaces according to a heat treatment temperature of the reflective layer according to a comparative example.

FIGS. **10** to **14** are views showing surfaces according to change in thickness of the reflective layer according to a comparative example and an embodiment.

FIGS. **15**(A) to **15**(D) are views showing a crystallographic structure of Ag and an example in which a crystal direction is changed according to thermal energy.

FIG. **16** is a graph showing comparison of intensity according to a difference in thickness of the reflective layer after the reflective layer is deposited according to an embodiment and a comparative example.

FIG. **17** is a graph showing comparison of intensity according to a difference in thickness of the reflective layer after the reflective layer is subjected to heat treatment according to an embodiment and a comparative example.

FIG. **18** is a view showing an average of light output of a wafer using the reflective layer according to an embodiment and comparison between light outputs of adjacent light emitting devices.

FIG. **19** is a table showing comparison of reflectance between an embodiment and a comparative example after heat treatment and after a bonding process in a wafer.

FIG. **20** is a view showing reflectance according to the thickness of the reflective layer of FIG. **19**.

FIG. **21** is a graph showing comparison of reflectance according to wavelength between an embodiment and a comparative example.

FIG. **22** is a side cross-sectional view of a light emitting device according to a second embodiment.

FIG. **23** is a view showing a light emitting device package including a light emitting device according to an embodiment.

FIG. **24** is a diagram showing a display apparatus including the light emitting device package of FIG. **23**.

FIG. **25** is a diagram showing another example of the display apparatus including the light emitting device package of FIG. **23**.

FIG. **26** is a diagram showing a lighting apparatus including the light emitting device package of FIG. **23**.

BEST MODE

Hereinafter, a light emitting device and a method of manufacturing the same according to embodiments will be described in detail with reference to the accompanying drawings. In the following description of the embodiments, it will be understood that, when each layer (film), region, pattern or structure is referred to as being formed "on" or "under" a substrate or each layer (film), region, pad, pattern or structure, it can be directly "on" or "under" a substrate or each layer (film), region, pad or pattern or be indirectly formed with one or more intervening layers therebetween. In addition, it will also be understood that "on" or "under" the layer may mean an upward direction and a downward direction of the layer.

FIG. **1** is a side cross-sectional view showing a light emitting device according to a first embodiment.

Referring to FIG. **1**, the light emitting device **100** may include a light emitting structure layer **135** having a plurality of compound semiconductor layers **110**, **120** and **130**, a first electrode **115** connected to the light emitting structure layer **135**, a contact layer **148** disposed under the light emitting structure layer **135**, a reflective layer **152** disposed under the contact layer **148**, a capping layer **154** disposed under the reflective layer **152**, a bonding layer **156** disposed under the capping layer **154**, and a support member **158** disposed under the bonding layer **156**.

The light emitting device **100** is a light emitting diode (LED) including compound semiconductors, e.g., compound semiconductors of Group II to VI elements. The light emitting device **100** includes the light emitting structure layer **135** including compound semiconductors of Group III-V elements and Group II-V elements, for example. The light emitting device **100** emits visible light or ultraviolet light.

An insulation layer **190** may be disposed on the side and upper surfaces of the light emitting structure layer **135**. The insulation layer **190** has a refractive index less than that of a compound semiconductor layer, e.g., a compound semiconductor layer of Group III-V elements and may be selected from among SiO_2, SiO_x, SiO_xN_y, Si_3N_4, Al_2O_3 and TiO_2.

The first electrode **115** may be disposed on the light emitting structure layer **135**. The first electrode **115** may be electrically connected to a first conductivity type semiconductor layer **110**. The first electrode **115** may include a pad or an electrode pattern having a branch structure connected to the pad. The first electrode **115** may include a single or plurality of pads, without being limited thereto. A roughness having irregularities may be formed on an upper surface of the first electrode **115**, without being limited thereto. A lower surface of the first electrode **115** may be formed in an uneven shape by a light extraction structure **112** of the light emitting structure layer **135**. The first electrode **115** may include a single layer or multiple layers by mixing any one or a plurality of metal materials selected from among Cr, Ti, Al, In, Ta, Pd, Co, Ni, Si, Ge, Ag, Cu and Au, for example.

The light emitting structure layer **135** includes a first conductivity type semiconductor layer **110**, an active layer **120** and a second conductivity type semiconductor layer **130**. The light emitting structure layer **135** may further include the other layers in addition to the layers **110**, **120** and **130**, without being limited thereto.

The light emitting structure layer **135** may be grown on a growth substrate using a growth apparatus such as an electron beam evaporator, a physical vapor deposition (PVD) device, a chemical vapor deposition (CVD) device, a plasma laser deposition (PLD) device, a dual-type thermal evaporator, a sputtering device, a metal organic chemical vapor deposition (MOCVD) device, etc., without being limited thereto.

The first conductivity type semiconductor layer **110** may be selected from among compound semiconductors of Group III-V elements doped with a first conductivity type dopant, such as GaN, AlN, AlGaN, InGaN, InN, InAlGaN, AlInN, AlGaAs, GaP, GaAs, GaAsP, AlGaInP, GaP, etc. The first conductivity type semiconductor layer **110** may include a semiconductor layer having a formula of $In_xAl_yGa_{1-x-y}N$ ($0 \le x \le 1$, $0 \le y \le 1$, $0 \le x+y \le 1$). The first conductivity type semiconductor layer **110** is an n-type semiconductor layer and the first conductivity type dopant includes n-type dopants such as Si, Ge, Sn, Se and Te. The first conductivity type semiconductor layer **110** may include a single layer or multiple layers, without being limited thereto. A roughness or pattern such as a light extraction structure **112** may be formed on the upper surface of the first conductivity type semiconductor layer **110**. In addition, for current spreading and light extraction, a transparent electrode layer may be selectively formed on the first conductivity type semiconductor layer **110**, without being limited thereto. The first conductivity type semiconductor layer **110** may be electrically connected to the first electrode **115**.

The active layer **120** may be disposed under the first conductivity type semiconductor layer **110** and may be formed in at least one of a single quantum well structure, a multi quantum well structure, a quantum-wire structure or a quantum dot structure. The active layer **120** may be formed of a cycle of a well layer and a barrier layer using compound semiconductor materials of Group II-VI elements and Group III-V elements. The active layer **120** may be formed of a cycle of an InGaN well layer/GaN barrier layer, a cycle of an InGaN well layer/AlGaN barrier layer or a cycle of an InGaN well layer/InGaN barrier layer. The barrier layer may be formed of a material having a band gap greater than that of the well layer. The active layer **120** may emit light having a peak wavelength of at least one of visible light and ultraviolet light.

A first clad layer and/or a second clad layer may be formed on and/or under the active layer **120**. The first and second clad layers may be formed of a GaN semiconductor and the band gap thereof may be greater than that of the barrier layer of the active layer **120**.

The second conductive semiconductor layer **130** is disposed under the active layer **120** and may be selected from among compound semiconductors of Group III-V elements doped with a second conductivity type dopant, such as GaN, AlN, AlGaN, InGaN, InN, InAlGaN, AlInN, AlGaAs, GaP, GaAs, GaAsP, AlGaInP and GaP. The second conductivity type semiconductor layer **130** may include a semiconductor layer having a formula of $In_xAl_yGa_{1-x-y}N$ ($0 \le x \le 1$, $0 \le y \le 1$, $0 \le x+y \le 1$). The second conductivity type semiconductor layer **130** is a p-type semiconductor layer and the second conductivity type dopant includes a p-type dopant such as Mg or Zn. The second conductivity type semiconductor layer **130** may include a single layer or multiple layers, without being limited thereto.

The side surface of the light emitting structure layer **135** may be vertical to or inclined to the lower surface of the light emitting structure layer **135**. The width of the upper surface

of the light emitting structure layer **135** may be equal to or greater than that of the lower surface of the light emitting structure layer **135**.

The light emitting structure layer **135** may further include a first conductivity type semiconductor layer under the second conductivity type semiconductor layer **130** and the first conductivity type semiconductor layer may have polarity opposite to that of the second conductivity type semiconductor layer. In addition, the first conductivity type semiconductor layer **110** may be a p-type semiconductor layer and the second conductivity type semiconductor layer **130** may be an n-type semiconductor layer. The light emitting structure layer **135** may include at least one of an n-p junction, a p-n junction, an n-p-n junction and a p-n-p junction. Hereinafter, for convenience of description, assume that the lowermost layer of the light emitting structure layer **135** is a second conductivity type semiconductor layer.

A plurality of conductive layers may be disposed under the second conductivity type semiconductor layer **130** and the plurality of conductive layers may be defined as a second electrode layer **160**. The second electrode layer **160** includes the contact layer **148**, the reflective layer **152**, the capping layer **154**, the bonding layer **156** and the support member **158**.

The contact layer **148** is disposed between the light emitting structure **135** and the reflective layer **152** and may be in contact with the lower surface of the second conductive semiconductor layer **130**. The width of the contact layer **148** may be equal to or different from that of the lower surface of the second conductivity type semiconductor layer **130**.

The contact layer **148** may include a transparent conductive material and may be in contact with the second conductivity type semiconductor layer **130**. The contact layer **148** may be an ohmic contact layer. The contact layer **148** may have a thickness in a range of 3 nm to 40 nm, for example, 3 nm to 10 nm and includes conductive oxide or conductive nitride. The contact layer may include at least one of indium tin oxide (ITO), indium zinc oxide (IZO), IZO nitride (IZON), indium zinc tin oxide (IZTO), indium aluminum zinc oxide (IAZO), indium gallium zinc oxide (IGZO), indium gallium tin oxide (IGTO), aluminum zinc oxide (AZO), antimony tin oxide (ATO) and gallium zinc oxide (GZO), for example.

The reflective layer **152** may be disposed under the contact layer **148** and the reflective layer **152** may be entirely or partially disposed on the lower surface of the contact layer **148**.

The reflective layer **152** is electrically connected to the contact layer **148** to supply voltage. A portion of the reflective layer **152** may be in contact with the second conductivity type semiconductor layer **130** through the contact layer **148**, without being limited thereto. The width of the reflective layer **152** may be equal to or greater than that of the light emitting structure layer **135**. If the width of the reflective layer **152** is greater than that of the contact layer **148**, it is possible to efficiently reflect incident light. Accordingly, it is possible to improve light extraction efficiency.

The reflective layer **152** may include a single layer or multiple layers selectively formed of Ag, Ni, Al, Rh, Pd, Ir, Ru, Mg, Zn, Pt, Au, Hf and a selective combination thereof. The reflective layer **152** may include Ag or an Ag alloy, for example, and may include a single layer.

The thickness of the reflective layer **152** may be greater than that of the second conductivity type semiconductor layer **130** or 20 or more times, e.g., 90 or more times the thickness of the contact layer **148**. The thickness of the reflective layer **152** is in a range of 700 to 1500 nm, for example, 800 to 1400 nm or 900 to 1300 nm. If the thickness of the reflective layer **152** is less than 700 nm, a plurality of holes or recesses may be formed due to heat treatment. The holes of the reflective layer **152** may be through-holes formed in the reflective layer and have an irregular shape when viewed from the capping layer. When the thickness of the reflective layer **152** exceeds 1500 nm, the thickness of the light emitting device becomes thick and there is no reflectance difference. The thickness of the reflective layer **152** according to the embodiment may be large enough not to form a hole, that is, a hole having an irregular shape, in the reflective layer **152**. Here, the hole having the irregular shape is formed by heat treatment and has a shape different from that of a hole formed through etching.

The capping layer **154** may be disposed between the reflective layer **152** and the bonding layer **156**. The capping layer **154** is in contact with the lower surface of the reflective layer **152** and protects the reflective layer **152**. That is, the capping layer **154** can prevent the material of the bonding layer **156** from diffusing into the reflective layer **152** and influencing the reflective layer **152** during a manufacturing process. The capping layer **154** may include a metal. For example, the capping layer may include at least one of Au, Cu, Ni, Ti, Ti—W, Cr, W, Pt, V, Fe and Mo. The thickness of the capping layer **154** may be in a range of 40 to 500 nm, for example, 40 nm to 60 nm. The thickness of the reflective layer **152** may be 15 or more times the thickness of the capping layer **154**.

The bonding layer **156** may be disposed between the capping layer **154** and the support member **158**. The bonding layer **156** includes a barrier metal or a bonding metal. For example, the bonding metal may include at least one of Sn, Ga, In, Bi, Cu, Ni, Ag, Mo, Al, Au, Nb, W, Ti, Cr, Ta, Al, Pd, Pt, Si, Al—Si, Ag—Cd, Au—Sb, Al—Zn, Al—Mg, Al—Ge, Pd—Pb, Ag—Sb, Au—In, Al—Cu—Si, Ag—Cd—Cu, Cu—Sb, Cd—Cu, Al—Si—Cu, Ag—Cu, Ag—Zn, Ag—Cu—Zn, Ag—Cd—Cu—Zn, Au—Si, Au—Ge, Au—Ni, Au—Cu, Au—Ag—Cu, Cu—Cu2 O, Cu—Zn, Cu—P, Ni—B, Ni—Mn—Pd, Ni—P and Pd—Ni. The thickness of the bonding layer **156** may be in a range of 5 to 9 μm, without being limited thereto. Any one of the bonding layer **156** and the capping layer **154** may be omited.

The support member **158** may be disposed under the bonding layer **156**. The support member **158** may be adhered to a circuit board using an adhesive member. The support member **158** may be implemented as a metal or carrier substrate, for example, a carrier substrate, into which Ti, Cr, Ni, Al, Pt, Au, W, Cu, Mo, Cu—W or impurities are injected. The carrier substrate may be formed of at least one of Si, Ge, GaN, GaAs, ZnO, SiC and SiGe, for example. The support member **158** supports the light emitting device **100** and the thickness thereof is 80% or more of the thickness of the second electrode layer **160** and may be in a range of 30 μm to 300 μm.

Referring to FIG. **2**, the reflective layer **152** is disposed under the light emitting structure layer **135** and the contact layer **148** and includes a flat upper surface and a lower surface **20** having an uneven structure. Light emitted from the light emitting structure layer **135** is radiated in all directions and the reflective layer **152** reflects light L**1** passing through the contact layer **148**. Since light L**1** reflected from the reflective layer **152** is radiated through an interface between the reflective layer **152** and the contact layer **148**, if the through-hole is formed in the reflective layer **152**, reflectance of the light L**1** may deteriorate.

The lower surface **20** of the reflective layer **152** includes protrusion portions **21** and recesses **23**, the recesses **23** may be convex in the direction of the light emitting structure layer **135**, and the protrusion portions **21** protrude in the direction of the capping layer **156** in a region between the recesses **23**.

A plurality of protrusion portions **21** may be formed on the lower surface **20** of the reflective layer **152** and a plurality of recesses may be formed between the plurality of protrusion portions **21**. The protrusion portions **21** may be provided between the recesses **23** and the recesses **23** may be provided between the protrusion portions **21**.

In the reflective layer **152**, the thickness T**2** between the recess **23** and the contact layer **148** or the upper surface of the reflective layer **152** may be less than the thickness T**1** between the protrusion portion **21** and the contact layer **148**.

In the reflective layer **152**, the thickness T**2** of the recess **23** may be greater than the depth T**3** of the recess **23**. The depth T**3** of the recess **23** may be less than 50% of the thickness T**1** of the reflective layer **152**, for example. The depth T**3** of the recess **23** may be the height of the protrusion portion **21**. The depth T**3** of the recess **23** may be equal to or less than 400 nm, for example, in a range of 10 nm to 400 nm. The thickness T**1** of the reflective layer **152** may be equal to that of a region in which the protrusion portion **21** is formed. In the embodiment, since the depth T**3** of the recess **23** of the reflective layer **152** is less than the thickness T**2** of the recess **23**, the through-hole is not formed in the reflective layer **152**. Accordingly, it is possible to prevent reflectance of the reflective layer **152** from deteriorating.

By the uneven structure of the lower surface **20** of the reflective layer **152**, the capping layer **154** may have an uneven structure or an uneven layer, without being limited thereto. Since the capping layer **154** has an uneven layer, a contact area with the lower surface **20** of the reflective layer **152** can be improved. The area of the lower surface **20** of the reflective layer **152** may be greater than that of the upper surface **10**.

FIGS. **3** to **5** are views showing a process of manufacturing the reflective layer of the light emitting device according to the embodiment.

Referring to FIG. **3**, the light emitting structure layer **135** is formed and then the contact layer **148** is formed on the light emitting structure layer **135**. The contact layer **148** may be formed using a sputtering or deposition method. The contact layer **148** includes any one of transparent conductive oxide or conductive nitride, without being limited thereto.

The reflective layer **152** is formed on the contact layer **148** and the reflective layer **152** may be deposited using an electron beam (E-beam) method or may be formed using a sputtering method or a plating method. The reflective layer **152** may be formed of metal having reflectance of 70% or more of, for example, Ag, Ni, Al, Rh, Pd, Ir, Ru, Mg, Zn, Pt, Au, Hf and a selective alloy thereof and may include a single layer or multiple layers. In addition, the reflective layer **152** may be formed of Ag or an Ag alloy, for example. At this time, the lower and upper surfaces of the reflective layer may be flat.

As shown in FIGS. **4** and **5**, when the thickness of the reflective layer **152** is in a range of 700 nm to 1500 nm, in order to improve adhesive properties or electrical properties, the reflective layer **152** is subjected to heat treatment. The heat treatment temperature is in a range of 250° C. to 550° C.

As shown in FIG. **4**, when the reflective layer **152** is subjected to heat treatment at a heat treatment temperature of 300° C.±50° C., the lower surface of the reflective layer **152** formed on the contact layer **148** is flat and the upper surface **20** of the reflective layer **152** has the protrusion portions **21** and the recesses **23**. Upon heat treatment, the reflective layer **152** moves to minimize a surface area thereof in order to reduce thermal energy and thus the recesses **23** and the protrusion portions **21** having small sizes are formed in the reflective layer **152** by the movement of the reflective layer. Thereafter, as shown in FIG. **5**, if the heat treatment temperature of the reflective layer **152** increases to 500° C.±50° C., an uneven structure having the recesses **23** and the protrusion portions **21** having sizes greater than those of the recesses **23** and the protrusion portions **21** of FIG. **4** may be formed in the upper surface **20** of the reflective layer **152**. That is, the distance D**2** between the protrusion portions **21** of FIG. **5** may be greater than the distance D**1** between the protrusion portions **21** of FIG. **4**. At this time, the number of recesses **23** and protrusion portions **21** formed in the reflective layer **152** of FIG. **5** is less than that of recesses **23** and protrusion portions **21** formed in the reflective layer **152** of FIG. **4** and the through-hole is not formed in the reflective layer. Since the through-hole is not formed in the reflective layer **152**, it is possible to prevent the optical and electrical properties of the reflective layer **152** from deteriorating. The curvature R**2** of the protrusion portion **21** of FIG. **5** may be greater than the curvature R**2** of the protrusion portion **21** of FIG. **4**.

If the thickness of the reflective layer **152** according to the embodiment is less than the above-described thickness, holes may be generated in the reflective layer **152** due to thermal stress upon heat treatment and reflectance may deteriorate due to the holes. As the thickness of the reflective layer **152** decreases, serious thermal degradation phenomenon may occur. In the embodiment, since the thickness of the reflective layer **152** is in a range of 700 nm to 1500 nm, it is possible to suppress a hole from being generated and to reduce thermal degradation phenomenon due to the thin reflective layer.

The capping layer **154** is formed on the reflective layer **152** and the capping layer **154** may be formed using a sputtering or deposition method. The bonding layer may be formed on the capping layer **154** and the support member may be formed on the bonding layer, without being limited thereto.

When the bonding layer and the support member are formed, heat and pressure may be applied such that the properties of the reflective layer do not deteriorate. Since the bonding processing temperature of the bonding layer is less than the heat treatment temperature of the reflective film, the surface of the reflective layer is rarely changed.

FIGS. **6** to **9** are views showing a process of manufacturing a reflective layer of a comparative example.

FIG. **6** shows a state in which an Ag reflective layer **51** having a thickness of 200 nm is deposited and heat treatment is not performed, and FIG. **7** shows a state in which the reflective layer **51** is subjected to heat treatment at 300° C. and thus a plurality of holes **52** is formed in the reflective layer **51**. As shown in FIG. **8**, when the reflection **51** is subjected to heat treatment at 500° C., the size of the hole **53** of the reflective layer **51** further increases. When the Ag reflective layer **51** is formed and then is subjected to heat treatment, the reflective layer **51** moves to minimize the surface area thereof in order to reduce thermal energy and thus holes **52** and **53** are formed in the reflective layer **51**. Thereafter, when the heat treatment temperature increases, the sizes of the holes **52** and **53** further increase and the widths of the protrusion portions of the reflective layer **51** further increase. Therefore, the width of the hole **53** after

heat treatment at a high temperature as shown in FIG. **8** may be greater than that of the hole **52** after heat treatment at a low temperature as shown in FIG. **7**. As shown in FIG. **9**, the reflective layer **51** may be modified to semispherical protrusion portions in order to minimize the surface area thereof. By the reflective layer **51** having the holes **52** and **53**, reflectance may deteriorate. In addition, as the number of protrusion portions generated in the reflective layers **51** increases, electrical contact deteriorates and thus electrical reliability decreases. In the comparative example, when the bonding process is performed after forming the reflective layer **51** having a small thickness, the properties of the reflective layer **51** deteriorates due to stress upon additional heat treatment.

FIGS. **10** to **14** are views showing the surface of the reflective layer according to the thickness of the reflective layer.

FIGS. **10** and **11** show reflective layers of comparative examples. FIG. **10** shows an example in which holes **61**A are formed in the reflective layer **61** by performing heat treatment at 400° C. in the case where the thickness of the reflective layer **62** is 200 nm. FIG. **11** shows an example in which holes **62**A are formed in the reflective layer **61** by performing heat treatment at 400° C. in the case where the thickness of the reflective layer **62** is 500 nm. As shown in FIGS. **10** and **11**, as the thicknesses the reflective layers **61** and **62** increase, the sizes of the holes **61**A and **62**A decrease and the number of holes **61**A and **62**A decreases.

FIGS. **12** to **14** show the thicknesses of the reflective layers according to the embodiment. As shown in FIG. **12**, if the thickness of the reflective layer **63** is 700 nm, when heat treatment is performed at a predetermined temperature, for example, 400° C., a hole is not formed in the reflective layer **63** and an uneven structure having recesses and protrusion portions **63**B is formed. As shown in FIG. **13**, if the thickness of the reflective layer **64** is 900 nm, when heat treatment is performed at a predetermined temperature, for example, 400° C., a hole is not formed in the reflective layer **64** and an uneven structure having recesses and protrusion portions **64**B is formed. As shown in FIG. **14**, if the thickness of the reflective layer **65** is 1100 nm, when heat treatment is performed at a predetermined temperature, for example, 400° C., a through-hole is not formed in the reflective layer **65** and an uneven structure having recesses and protrusion portions **65**B is formed. As shown in FIGS. **12** to **14**, as the thicknesses of the reflective layers **63**, **64** and **65** increase, the sizes of the protrusion portions **63**B, **64**B and **65**B increase due to thermal stability and thus the number of protrusion portions decreases. As the thicknesses of the reflective layers **63**, **64** and **65** gradually increase from 70 nm, thermal energy is sufficiently reduced and thus agglomeration is reduced.

FIGS. **15**(A) to **15**(D) are views showing a crystallographic structure of silver (Ag) and an example in which a crystal direction is changed according to thermal energy.

FIG. **15**(A) shows a face centered cubic (FCC) of Ag and the closest-packed direction of atoms is a direction (111) among (B), (C) and (D) of FIG. **15**. That is, when thermal energy is applied to Ag through heat treatment, the crystal direction (110 or 100) is changed to a direction (111). When the Ag reflective layer has constant directivity in the direction (111), reflectance of Ag can be improved.

FIGS. **16** and **17** show a difference in the crystal direction of Ag according to the thickness of Ag as a result of measuring the crystal direction of Ag using a measurement apparatus, for example, an X-ray diffraction (XRD) apparatus. FIG. **16** shows intensity before heat treatment and FIG. **17** shows intensity after heat treatment, when the thickness of the Ag reflective layer is 200 nm, 500 nm, 700 nm, 900 nm and 1100 nm.

As shown in FIGS. **16** and **17**, the Ag reflective layer has highest intensity in the direction (111) when the thickness thereof is 900 nm. When the thickness of the Ag reflective layer is about 900 nm, crystallizability of the Ag reflective layer is excellent.

FIG. **18** is a view showing an average of light output of a wafer using the reflective layer according to an embodiment and comparison between light outputs of adjacent light emitting devices.

Referring to FIG. **18**, (A) shows a light output average in the wafer and (B) and (C) show comparison between adjacent chips in the wafer. It can be seen that the light output Po of the reflective layer having a thickness of 900 nm increases as compared to the light output of the comparative example Ref. It can be seen that the light output Po increases by 2.5% or more.

FIG. **19** is a table showing comparison of reflectance between an embodiment and a comparative example after heat treatment and after a bonding process in a wafer. FIG. **20** is a view showing reflectance according to the thickness of the reflective layer of FIG. **19**.

As shown in FIGS. **19** and **20**, in the case where the thickness of the reflective layer (Ag) is 200 nm, 500 nm, 900 nm and 130 nm, when the reflectance differences Δreflectance of wafers **1**, **2** and **3** after heat treatment at a predetermined temperature, e.g., 400° C. and after bonding are compared, it can be seen that the reflectance difference when the thickness of the reflective layer is 900 nm is less than that when the thickness of the reflective layer is 200 nm in the wafers **1**, **2** and **3**. That is, it can be seen that, when the bonding process is performed after forming the reflective layer, influence of stress caused by heat and pressure is low.

That is, in the case where the thickness of the reflective layer is 200 to 500 nm, the Ag reflective layer does not deteriorate due to heat treatment at a predetermined temperature, e.g., 400° C. but thermal decomposition is generated in the bonding process. Therefore, it can be seen that reflectance deteriorates. In the embodiment, even when the reflective layer having the thickness of 900 nm or more is subjected to a bonding process after heat treatment, reflectance does not further deteriorate.

FIG. **21** is a graph showing comparison of reflectance between an embodiment and a comparative example according to wavelength.

In FIG. **21**, a graph showing comparison between the embodiment, in which the thickness of the reflective layer is 900 nm, and the comparative example, in which the thickness of the reflective layer is 200 nm, after heat treatment and after bonding is shown. The reflectance difference of the reflective layer of the comparative example between before bonding and after bonding is greater than that of the reflective layer of the embodiment between before bonding and after bonding.

FIG. **22** is a side cross-sectional view of a light emitting device according to a second embodiment.

Referring to FIG. **22**, the light emitting device may includes a light emitting structure layer **135** having a plurality of compound semiconductor layers **110**, **120** and **130**, a first electrode **116**, a contact layer **148**, the reflective layer **152** according to the embodiment, a passivation layer **171**, a capping layer **154**, a bonding layer **174** and a support member **175**.

The contact layer **148**, the reflective layer **152** and the capping layer **154** are disposed under the light emitting

structure layer **135**, and the contact layer **148**, the reflective layer **152** and the capping layer **154** may be electrically connected to a second conductivity type semiconductor layer **130**. The contact layer **148**, the reflective layer **152** and the capping layer **154** may define a second electrode layer **150**. The reflective layer **152** is the reflective layer disclosed in the first embodiment. For a detailed description of the reflective layer **152**, refer to the description of the first embodiment. The reflective layer **152** does not have a through-hole formed therein and the thickness thereof may be in a range of 700 nm to 1500 nm, for example, 800 to 1400 nm or 900 to 1300 nm. The lower surface of the reflective layer **152** may include an uneven structure having a plurality of protrusion portions and a plurality of recesses disposed between the plurality of protrusion portions.

One or a plurality of first electrodes **116** may be provided outside the sidewall of the light emitting structure layer **135** and may contact at least one of the contact layer **148**, the reflective layer **152** and the capping layer **154**. For the contact layer **148**, the reflective layer **152** and the capping layer **154**, refer to the description of the first embodiment.

In the embodiment, the thickness of the reflective layer **152** is greater than that of the second conductivity type semiconductor layer **130** or is 20 times that of the contact layer **148**. The thickness of the reflective layer **152** may be in a range of 700 to 1500 nm, for example, 800 to 1400 nm or 900 to 1300 nm. If the thickness of the reflective layer **152** is less than 700 nm, a plurality of through-holes and recesses may be formed due to heat treatment and the shapes of the through-holes may be irregular when viewed from the capping layer. In addition, when the thickness of the reflective layer **152** exceeds 1500 nm, the thickness of the light emitting device increases and there is no reflectance difference.

In the embodiment, the reflective layer **152** may have a thickness enough not to form the through-hole in the reflective layer **152**. That is, the reflective layer **152** without the hole having the irregular shape may be formed. Here, the hole having the irregular shape is formed by heat treatment and has a shape different from that of a hole formed through etching. Here, the hole having the irregular shape has a depth equal to the thickness of the reflective layer **152** and may be distinguished from a via hole **170**.

The capping layer **154** may be formed as an uneven layer according to the uneven structure of the lower surface of the reflective layer **152**, without being limited thereto.

The via hole **170** is formed in the light emitting structure layer **135** and the second electrode layer **150**. The via hole **170** may be formed from the capping layer **154** to the lower portion of the first conductivity type semiconductor layer **110** and the passivation layer **171** is formed on the circumference thereof.

The passivation layer **171** is disposed between the second electrode layer **150** and the first electrode layer **160**A to electrically insulate the second electrode layer **150** and the first electrode layer **160**A.

The first electrode layer **160**A includes a conductive layer **173**, a bonding layer **174** and a support member **175**. The conductive layer **173** is disposed under the lower portion of the first conductivity type semiconductor layer **110** and is in contact with the first conductivity type semiconductor layer **110**. A portion of the bonding layer **174** extends to the lower portion of the light emitting structure layer **135** and is in contact with the conductive layer **173**.

The support member **175** is disposed under the bonding layer **174** to support the light emitting device.

FIG. **23** is a view showing a light emitting device package including a light emitting device according to an embodiment.

Referring to FIG. **23**, the light emitting device package according to the embodiment may include a body **120**, a first lead electrode **131** and a second lead electrode **132** disposed on the body **120**, the light emitting device **100** according to the embodiment, which is provided on the body **120** to electrically connect the first lead electrode **131** and the second lead electrode **132**, and a molding member **140** surrounding the light emitting device **100**.

The body **120** may include a silicon material, a synthetic resin material or a metal material and includes a cavity having an inclined surface around the light emitting device **100**.

The first lead electrode **131** and the second lead electrode **132** are electrically disconnected from each other to supply a voltage to the light emitting device **100**. In addition, the first lead electrode **131** and the second lead electrode **132** may reflect light generated in the light emitting device **100** to increase light efficiency and discharge heat generated in the light emitting device **100**.

The light emitting device **100** may be disposed on the body **120**, the first lead electrode **131** or the second lead electrode **132**.

The light emitting device **100** may be electrically connected to the first lead electrode **131** and the second lead electrode **132** using any one of a wiring method, a flip chip method or a die bonding method.

The molding member **140** may surround the light emitting device **100** to protect the light emitting device **100**. In addition, phosphors may be included in the molding member **140** to change the wavelength of light emitted from the light emitting device **100**.

A plurality of light emitting devices or light emitting device packages according to the embodiment may be arranged on a substrate and a lens, a light guide plate, a prism sheet, a diffusion sheet, etc. which are optical members, may be provided on an optical path of the light emitting device packages. Such light emitting device package, substrate and optical member may function as a light unit. The light unit is implemented in a top view or a side view type and is provided in a display device of a portable terminal and a laptop or is applicable to a lighting device and an indicator device.

Another embodiment may be implemented as a lighting apparatus including the light emitting devices or light emitting device packages according to the above-described embodiments. For example, the lighting apparatus may include a lamp, a streetlamp, an outdoor display board, a headlight, etc. The lighting apparatus according to the embodiment is applicable to the taillight of a vehicle in addition to the headlight.

The light emitting device according to the embodiment is applicable to a light unit. The light unit has a structure in which a plurality of light emitting devices is arranged and may include display apparatuses shown in FIGS. **24** and **25** and a lighting apparatus shown in FIG. **26**.

Referring to FIG. **24**, the display apparatus **1000** according to the embodiment may include a light guide plate **1041**, a light emitting module **1031** for providing light to the light guide plate **1041**, a reflective member **1022** disposed under the light guide plate **1041**, an optical sheet **1051** disposed on the light guide plate **1041**, a display panel **1061** disposed on the optical sheet **1051**, and a bottom cover **1011** for accommodating the display panel **1061**, the light guide plate **1041**,

the light emitting module **1031** and the reflective member **1022**, without being limited thereto.

The bottom cover **1011**, the reflective member **1022**, the light guide plate **1041** and the optical sheet **1051** may be defined as a light unit **1050**.

The light guide plate **1041** serves to diffuse light to convert light into surface light. The light guide plate **1041** may be formed of a transparent material and may include one of acrylic resin of polymethyl methacrylate (PMMA), polyethylene terephthalate (PET), polycarbonate (PC), cycloolefin copolymer (COP) and polyethylene naphthalate (PEN) resin.

The light emitting module **1031** provides light to at least one side surface of the light guide plate **1041** and functions as a light source of a display apparatus.

At least one light emitting module **1031** may be provided in the bottom cover **1011** to directly or indirectly provide light at one side of the light guide plate **1041**. The light emitting module **1031** may include a substrate **1033** and the light emitting devices or light emitting device packages **200** according to the above-described embodiment provided thereon. The light emitting device packages **200** may be arranged on the substrate **1033** at a predetermined interval.

The substrate **1033** may be a printed circuit board (PCB) including a circuit pattern. The substrate **1033** may include a normal PCB, a metal core PCB (MCPCB), a flexible PCB (FPCB), etc., without being limited thereto. If the light emitting device package **200** is provided on the side surface of the bottom cover **1011** or on a heat dissipation plate, the substrate **1033** may be omitted. Here, a portion of the heat dissipating plate may contact an upper surface of the bottom cover **1011**.

The plurality of light emitting device packages **200** may be mounted such that an exit surface for emitting light is spaced apart from the light guide plate **1041** by a predetermined distance, without being limited thereto. The light emitting device package **200** may directly or indirectly provide light to an incident surface which is one surface of the light guide plate **1041**, without being limited thereto.

The reflective member **1022** may be disposed under the light guide plate **1041**. The reflective member **1022** may reflect light incident on the lower surface of the light guide plate **1041** to direct light upward, thereby improving brightness of the light unit **1050**. Although the reflective member **1022** may be formed of, for example, PET, PC, PVC resin, etc., the present invention is not limited thereto. Although the reflective member **1022** may be the upper surface of the bottom cover **1011**, the present invention is not limited thereto.

The bottom cover **1011** may accommodate the light guide plate **1041**, the light emitting module **1031** and the reflective member **1022**. To this end, the bottom cover **1011** may include an accommodation part **1012** having a box shape having an opened upper surface thereof, without being limited thereto. The bottom cover **1011** may be coupled to a top cover, without being limited thereto.

The bottom cover **1011** may be formed of a metal material or a resin material and may be manufactured using a press molding process or an extrusion molding process. The bottom cover **1011** may include a metal material having good heat conductivity or a non-metal material, without being limited thereto.

The display panel **1061** is, for example, an LCD panel and includes first and second substrates facing each other and formed of a transparent material and a liquid crystal layer interposed between the first and second substrates. A polarization plate may be attached to at least one surface of the display panel **1061** and the attachment structure of the polarization plate is not limited thereto. The display panel **1061** displays information by light passing through the optical sheet **1051**. The display apparatus **1000** is applicable to various mobile terminals, a monitor of a laptop, a television, etc.

The optical sheet **1051** is disposed between the display panel **1061** and the light guide plate **1041** and includes at least one transparent sheet. The optical sheet **1051** may include at least one of a diffusion sheet, a horizontal prism sheet, a vertical prism sheet, and a brightness enhancement sheet. The diffusion sheet diffuses incident light, and the horizontal and/or vertical prism sheets focus incident light onto a display region and the brightness enhancement sheet reuses lost light to enhance brightness. A protective sheet may be provided on the display panel **1061**, without being limited thereto.

Here, the light guide plate **1041** and the optical sheet **1051** may be included on the optical path of the light emitting module **1031** as optical members, without being limited thereto.

FIG. **25** is a diagram showing another example of the display apparatus according to the embodiment.

Referring to FIG. **25**, the display apparatus **100** may include a bottom cover **1152**, a substrate **1020**, on which the light emitting devices **100** are arranged, an optical member **1154**, and a display panel **1155**. The substrate **1020** and the light emitting device package **200** may be defined as a light emitting module **1060**. The bottom cover **1152** may include an accommodation part **1153**, without being limited thereto.

Here, the optical member **1154** may include at least one of a lens, a light guide plate, a diffusion sheet, horizontal and vertical prism sheets and a brightness enhancement sheet. The light guide plate may be formed of a PC material or a PMMA material and may be omitted. The diffusion sheet diffuses incident light, and the horizontal and/or vertical prism sheets focus incident light onto a display region and the brightness enhancement sheet reuses lost light to enhance brightness.

The optical member **1154** is disposed on the light emitting module **1060** and converts light emitted from the light emitting module **1060** into surface light or diffuses or focus light.

FIG. **26** is a diagram showing a lighting apparatus according to an embodiment.

Referring to FIG. **26**, the lighting apparatus according to the embodiment may include a cover **2100**, a light source module **2200**, a heat dissipating body **2400**, a power supply **1600**, an inner case **2700**, and a socket **2800**. In addition, the lighting apparatus according to the embodiment may further include one or more of a member **2300** and a holder **2500**. The light source module **220** may include the light emitting device package according to the embodiment.

For example, the cover **2100** has a bulb or semispherical shape, the inside thereof is hollow and a portion thereof is opened. The cover **2100** may be optically coupled to the light source module **2200**. For example, the cover **2100** may diffuse, scatter or excite light received from the light source module **2200**. The cover **2100** may be an optical member. The cover **2100** may be coupled with the heat dissipating body **2400**. The cover **2100** may have a coupling part for coupling with the heat dissipating body **2400**.

The inner surface of the cover **2100** may be coated with a milky coating material. The milky coating material may include a diffusion material. The surface roughness of the inner surface of the cover **2100** may be greater than that of

the outer surface of the cover **2100**, in order to sufficiently diffuse and scatter light from the light source module **220** to emit light.

The material of the cover **2100** may be glass, plastic, polypropylene (PP), polyethylene (PE), polycarbonate (PC), etc. Here, polycarbonate is excellent in terms of light resistance, thermal resistance and strength. The cover **2100** may be transparent such that the light source module **220** is visible from outside or may not be transparent. The cover **2100** may be formed through blow molding.

The light source module **2200** may be disposed on one surface of the heat dissipating body **2400**. Accordingly, heat from the light source module **2200** is transferred to the heat dissipating body **2400**. The light source module **2200** may include light sources **2210**, a connection plate **2230** and a connector **2250**.

The member **2300** is disposed on the upper surface of the heat dissipating body **2400** and has guide grooves **2310**, into which the plurality of light sources **2210** and the connector **2250** are inserted. The guide grooves **2310** correspond to the substrates of the light sources **2210** and the connector **2250**.

The surface of the member **2300** may be applied or coated with a reflective material. For example, the surface of the member **2300** may be applied or coated with a white coating material. The member **2300** reflects light reflecting from the inner surface of the cover **2100** and returning to the light source module **2200** toward the cover **2100** again. Accordingly, light efficiency of the lighting apparatus according to the embodiment can be improved.

The member **2300** may be formed of an insulation material. The connection plate **2230** of the light source module **2200** may include an electrical conduction material. Accordingly, the heat dissipating body **2400** and the connection plate **2230** may be electrically connected to each other. The member **2300** is formed of an insulation material to disconnect the connection plate **2230** and the heat dissipating body **2400**. The heat dissipating body **2400** dissipates heat from the light source module **2200** and heat from the power supply **2600**.

The holder **2500** blocks the accommodation groove **2719** of the insulation part **2710** of the inner case **2700**. Accordingly, the power supply **2600** accommodated in the insulation part **2710** of the inner case **2700** is enclosed. The holder **2500** has a guide protrusion **2610**. The guide protrusion **2510** has a hole, through the protrusion **2610** of the power supply **2600** penetrates.

The power supply **2600** processes or converts an external electrical signal and supplies the converted or processed signal to the light source module **2200**. The power supply **2600** is accommodated in the accommodation groove **2719** of the inner case **2700** and is enclosed in the inner case **2700** by the holder **2500**. The power supply **2600** may include the protrusion **2610**, a guide **2630**, a base **2650** and an extension **2670**.

The guide **2630** protrudes from one side of the base **2650** outwardly. The guide **2630** may be inserted into the holder **2500**. A plurality of parts may be disposed on one surface of the base **2650**. The plurality of parts may include, for example, an AC-DC converter for converting an AC voltage received from an external power supply into a DC voltage, a driving chip for controlling driving of the light source module **2200**, and an electrostatic discharge (ESD) protection device for protecting the light source module **220**, without being limited thereto.

The extension **2670** protrudes from another side of the base **2650** outwardly. The extension **2670** is inserted into the connector **2750** of the inner case **2700** to receive an external electrical signal. For example, the width of the extension **2670** may be equal to or less than that of the connector **2750** of the inner case **2700**. One end of each of a "+wire" and a "−wire" is electrically connected to the extension **2670** and the other end of each of the "+wire" and the "−wire" is electrically connected to the socket **2800**.

The inner case **2700** may include a molding part provided therein in addition to the power supply **2600**. The molding part is obtained by hardening molding liquid and fixes the power supply **2600** in the inner case **2700**.

The embodiment can improve the light output of the light emitting device. The embodiment provides a light emitting device for improving reflectance of a reflective layer disposed under a light emitting structure layer. The embodiment can improve optical property deterioration of a light emitting device. The embodiment can improve reliability of a light emitting device and a light emitting device package, lighting apparatus and display apparatus including the same.

The features, structures and effects of the embodiments are included in at least one embodiment of the present invention and are not limited to one embodiment. Further, the features, structures and effects of each embodiment may be combined or modified by those skilled in the art in other embodiments. Accordingly, the description related to such combinations and modifications should be interpreted as being within the scope of the present invention.

Although the preferred embodiments have been disclosed, the embodiments are purely exemplary and do not limit the present disclosure. Those skilled in the art will appreciate that various modifications and applications are possible, without departing from the embodiments. For example, the components described in the embodiments may be modified and embodied. Further, differences related to such modifications and applications should be interpreted as being within the scope of the present disclosure defined by the accompanying claims.

INDUSTRIAL APPLICABILITY

Embodiments can improve reliability of a light emitting device.

The light emitting device according to embodiments is applicable to a lighting apparatus such as an illumination lamp, an indoor lamp, an outdoor lamp, an indicator lamp and a headlight using an LED.

The invention claimed is:

1. A light emitting device comprising:

a light emitting structure layer including a first conductivity type semiconductor layer, a second conductivity type semiconductor layer disposed under the first conductivity type semiconductor layer and an active layer disposed between the first conductivity type semiconductor layer and the second conductivity type semiconductor layer;

a first electrode electrically connected to the first conductivity type semiconductor layer;

a contact layer disposed under the second conductivity type semiconductor layer and formed of a conductive material;

a reflective layer disposed under the contact layer;

a capping layer disposed under the reflective layer; and

a conductive support member disposed under the capping layer,

wherein a thickness of the reflective layer is greater than that of the second conductivity type semiconductor layer and is 90 or more times that of the contact layer,

wherein a lower surface of the reflective layer includes a plurality of protrusion portions and a plurality of recesses disposed between the plurality of protrusion portions,
wherein the lower surface of the reflective layer includes an uneven structure with respect to a horizontal top surface of the conductive support member,
wherein the reflective layer is formed of Ag,
wherein the reflective layer is formed of a single layer, and
wherein the thickness of the reflective layer is 15 or more times that of the cap ping layer.

2. The light emitting device according to claim **1**, wherein the thickness of the reflective layer is in a range of 900 nm to 1300 nm.

3. The light emitting device according to claim **2**, wherein an area of the lower surface of the reflective layer is greater than that of an upper surface of the reflective layer.

4. The light emitting device according to claim **3**, wherein the capping layer includes an uneven layer along the lower surface of the reflective layer.

5. The light emitting device according to claim **3**, wherein a bonding layer is included between the capping layer and the support member.

6. The light emitting device according to claim **1**, further comprising an insulating layer disposed on side and upper surfaces of the first conductivity type semiconductor layer,
wherein the first electrode is disposed on the first conductivity type semiconductor layer and is electrically connected to the first conductivity type semiconductor layer.

7. The light emitting device according to claim **1**, wherein each of the plurality of protrusion portions has a curved surface.

8. The light emitting device according to claim **1**, wherein each of the plurality of protrusion portions has a convex surface in a direction of the capping layer.

9. The light emitting device according to claim **1**, further comprising an insulating layer disposed on side surfaces and an upper surface of the first conductivity type semiconductor layer,
wherein the first electrode is disposed on the first conductivity type semiconductor layer and is electrically connected to the first conductivity type semiconductor layer, and
wherein the upper surface of the first conductivity type semiconductor layer has a light extraction structure.

10. A light emitting device comprising:
a light emitting structure layer including a first conductivity type semiconductor layer, a second conductivity type semiconductor layer disposed under the first conductivity type semiconductor layer and an active layer disposed between the first conductivity type semiconductor layer and the second conductivity type semiconductor layer;
a first electrode electrically connected to the first conductivity type semiconductor layer;
a contact layer disposed under the second conductivity type semiconductor layer and formed of a conductive material;
a reflective layer disposed under the contact layer;
a capping layer disposed under the reflective layer; and
a conductive support member disposed under the capping layer,
wherein a thickness of the reflective layer is greater than that of the second conductivity type semiconductor layer and is 90 or more times that of the contact layer,
wherein a lower surface of the reflective layer includes a plurality of protrusion portions and a plurality of recesses disposed between the plurality of protrusion portions,
wherein the lower surface of the reflective layer includes an uneven structure with respect to a horizontal top surface of the conductive support member,
wherein the thickness of the reflective layer is greater than 15 or more times that of the capping layer, and
wherein a depth of each of the recesses is less than 50% of the thickness of the reflective layer.

11. The light emitting device according to claim **10**, wherein the protrusion portions have a semi-spherical shape.

12. The light emitting device according to claim **10**, wherein the depth of each of the recesses has a range of 100 nm to 400 nm.

13. The light emitting device according to claim **10**, wherein an area of the lower surface of the reflective layer is greater than that of an upper surface of the reflective layer.

14. The light emitting device according to claim **13**, wherein the reflective layer is formed of Ag.

15. The light emitting device according to claim **14**, wherein the thickness of the reflective layer is in a range of 900 nm to 1300 nm.

16. The light emitting device according to claim **15**, wherein the contact layer includes a transparent conductive material.

17. The light emitting device according to claim **16**, wherein:
a bonding layer is disposed between the capping layer and the conductive support member,
the first conductivity type semiconductor layer includes an n-type semiconductor layer, and
the second conductivity type semiconductor layer includes a p-type semiconductor layer.

18. The light emitting device according to claim **10**, wherein the reflective layer is formed of a single layer formed of Ag.

19. The light emitting device according to claim **10**, wherein each of the plurality of protrusion portions has a curved surface.

20. The light emitting device according to claim **10**, wherein each of the plurality of protrusion portions has a convex surface in a direction of the capping layer.

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